

Fly on the right: lateral preferences when choosing aircraft seats.

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## Abstract

A small preference has been observed for people to choose seats on the left of aircraft when booking via an online system. Although this is consistent with pseudoneglect – the known leftward bias in perception and representation - rightward preferences have been commonly observed in seating selection tasks in other environments. Additionally, the previous research in aircraft seating was unable to dissociate a bias to one side of the screen from a bias to one side of the cabin of the aircraft. Here we present a study in which participants were asked to select seats for a range of fictional flights. They demonstrated a preference for seats on the right of the cabin, irrespective of whether the right of the cabin appeared to either the right or the left of the screen, a preference for seats towards the front of the aircraft and a preference to favour window and aisle seats. This suggests, in contrast to previous research, that participants demonstrated a rightward lateral bias to representations of an aircraft. These results may have implications for our understanding of asymmetries in cognition as well as having potentially important practical implications for airlines.

Keywords: laterality, behavioural asymmetry, pseudoneglect, representational pseudoneglect, aviation, seat preference.

RUNNING HEAD: Aircraft seat preferences

## Fly on the right: lateral preferences when choosing aircraft seats.

There are several human behaviours in which a tendency exists to prefer one side rather than the other of a particular stimulus – including cradling infants (Salk, 1960), kissing (Güntürkün, 2003), portraiture (Nicholls, Clode, Wood & Wood, 1999), and sport (putting in golf: Roberts & Turnbull, 2010; kicking in football: Nicholls, Loetscher & Rademacher, 2010).

One area where a lateral preference may influence behaviour is in the selection of seats in an aircraft. Some media reports have suggested that passengers show preferences for certain seats, though the direction of that preference is unclear. The budget airline, 'EasyJet' issued a press release in 2012 summarising the results of a trial of their new booking system, stating that passengers preferred seats on the left hand side of the cabin (EasyJet introduces allocated seating, 2012). However, a subsequent release (2B or not 2B, 2014) stated that passengers in a survey expressed a preference for seats on the right, an observation mirrored in a British Airways study (reported in the news media) on seat preference in wide-body jets claiming that 54% of people selected the right hand side as their first choice (Smith, 2013). The full methodological details and results of these studies are unfortunately not available.

Nicholls, Thomas and Loetscher (2013) surveyed seat booking maps on real websites for 100 different flights and 37 theatre performances, and observed that there was some evidence of a bias to the right in selections for theatres, and stronger evidence of a bias to the left in selection for air travel. Whilst the bias to the right in theatres is broadly consistent with previous work (Karev, 2000; Okubo, 2010; Weyers, Milnik, Müller and Pauli, 2006; Harms, Reese & Elias, 2014), the bias to the left in aircraft was a novel finding. To account for it Nicholls et al. postulated either a right turning bias (after Scharine & McBeath, 2002) or a feeling of proximity to the entrance (universally on the left in aircraft) as potential explanations. A leftwards bias has subsequently also been reported for classrooms (Harms, Poon, Smith & Elias, 2015), these authors interpreting the contrast with bias previously observed in cinemas (Harms, et al. (2014) as an effect of

“expectation bias”, with expectation of emotional processing in cinemas biasing seat choice to the right, whilst expectation of verbal interaction in the classroom biasing choice to the left.

There is substantial evidence that human visual attention is subject to small but systematic lateral biases. For instance, if asked to bisect horizontal lines, people tend to place the bisection point slightly to the left of the veridical mid-point (Jewell & McCourt, 2000). These kinds of lateral biases in spatial attention are labelled ‘pseudoneglect’ (Bowers & Heilman, 1980) as they resemble the clinical signs of Unilateral Spatial Neglect (e.g. Bartolomeo, 2014; Cubelli, 2017), though much smaller and in the opposite direction (Brooks, Darling, Malvaso, Della Sala, 2016; Thomas, Aniulis & Nicholls, 2016). As with Unilateral Spatial Neglect (Bisiach and Luzzatti, 1978; Beschin, Cocchini, Della Sala & Logie, 1997), pseudoneglect can also be observed in the representational domain (Brooks, Della Sala & Logie, 2011a; Brooks, Logie, McIntosh & Della Sala, 2011b; Friedman, Mohr & Brugger, 2012; McGeorge, Beschin, Colnaghi, Rusconi & Della Sala, 2007). It is possible that biases in seat choice relate to pseudoneglect type biases.

The study by Nicholls et al. (2013) was high in ecological validity, given it represented a survey of seatplans from live booking sites. However, that ecological validity brings with it some considerable difficulties in interpretation. Booking screens contain directional cues in the format of the text used to identify seats, which invariably conflates the left of the cabin with letters toward the start of the alphabet, so that in typical narrow body airliners the left hand seats are labelled A,B and C, with those on the right labelled D,E and F. This represents a potential confounding variable when seat maps are used – participants may prefer certain letters over others, and evidence of SNARC effects on alphabetic tasks (Gevers, Reynvoet & Fias, 2003) is also suggestive of links between spatial and alphabetic representations

A second unresolved question in the Nicholls et al. (2013) study involves decoupling screen bias from vehicle bias. All of the cabins presented in that study were oriented with the nose towards the top of the screen. Hence it is unclear whether participants were biased to the left of perceived space on the screen, or to the left of the participant’s representation of the aircraft cabin. Without decoupling potential screen bias

from bias related to the vehicle it is impossible to know whether passengers preferred to plan to sit on the left hand side of the *aircraft*, or that they preferred to choose seats on the left hand side of the *screen*.

A third issue with interpretation of data from live airline websites is that there is a lack of transparency according to how seats are allocated – whether some seats are allocated algorithmically prior to allowing passengers to make their selections, or whether prior block bookings or system-related protocols have played a role in the apparently empty seats available. This is potentially additive to a fourth major disadvantage with both live websites and live event observation – both are prone to unpredictable effects of the interaction of later selections of seats with earlier choices. Choosers may well load their seat decision according to which other seats have already been selected –inferring a directionality of latent bias may be difficult in such complex and multiply determined environments.

As an example, assume people are selecting seats from a single row of 6 seats (A-F, with A on the left) and that (i) individuals are biased to prefer a seat on the left of a cabin and (ii) people wish to sit as far as possible from a stranger. Should the first person choose to sit in the leftmost seat (A), the second will choose the rightmost (F), the third will choose seat C, the fourth D, the fifth B and the sixth E. The upshot of this is that the seats will tend to fill up in a balanced way, and likely obscure lateral biases.

A final problem is that there may well be a complexity of factors involved in selecting seats. Capturing the selection of seats at live events or in live websites is likely to capture many other phenomena relating to the design of the rooms/vehicles involved, as well as social interactions within the attendees. Furthermore, couples and families who wish to travel together, personal preferences for aisle and window seats or front or rear seats, presence of exits, galleys, toilets and other asymmetries in layouts may well serve to complicate the choice process. Mild cognitive biases like pseudoneglect are unlikely to supersede such explicit preferences and hence may either be obscured or produce unexpected effects in observational ecological research like that of Nicholls et al. (2013) and Harms et al. (2014, 2015).

There is much to be gained in the assessment of behaviour using ecologically valid, realistic methods. In this case, though, for the reasons outlined above, they may impose limiting factors on understanding the role of pseudoneglect and seat selection. If so, then it could be argued that they are inappropriate methods for this purpose. Certainly, the field seems bedevilled by a lack of consistency across published results – and across environments, and explanations of these so far (such as that of Harms et al., 2015) have been distinctly post-hoc in nature.

The present study sought to ask again whether there is evidence for a lateral bias in aircraft seat selection - but using a seat map system where a participant's selection was independent of other peoples' seat choices (i.e. they selected a seat in an empty cabin). This method also allowed us to systematically vary the vertical orientation of the seat maps and the direction of seat labelling, as well as using a completely symmetrical seating plan with no lateral positioning of toilets and galleys, and which was not obviously identifiable as a specific, potentially familiar, aircraft type. Our prediction was that we would replicate the left-side bias in aircraft seating (Nicholls et al., 2013). Furthermore, our design would illuminate whether this reflected a perceptual-attentional bias to the computer screen, or whether instead the bias could be due to the representation of the aircraft cabin itself.

## Method

### Participants

Thirty-two participants were recruited for this study, 21 females and 11 males, aged between 21 and 31 years old ( $M=24.72$ ,  $SD=2.77$ ). All participants were right-handed on the Edinburgh Handedness Inventory (Oldfield, 1971: Laterality Quotient  $\bar{x} = 75.22$ ,  $SD = 20.65$ , range =  $25 < X < 100$ ). They were recruited via advertisements in student websites and student accommodation notice boards at Edinburgh University, and although the majority were students, not being a student was not an exclusion criterion. All participants had normal or corrected-to-normal vision. Informed consent was obtained at the beginning of

the experimental session. Participants received a small compensation for their time. This research complied with the British Psychological Society Code of Ethics and Conduct and was approved by the Psychological Research Ethics Committee (PREC) at the University of Edinburgh.

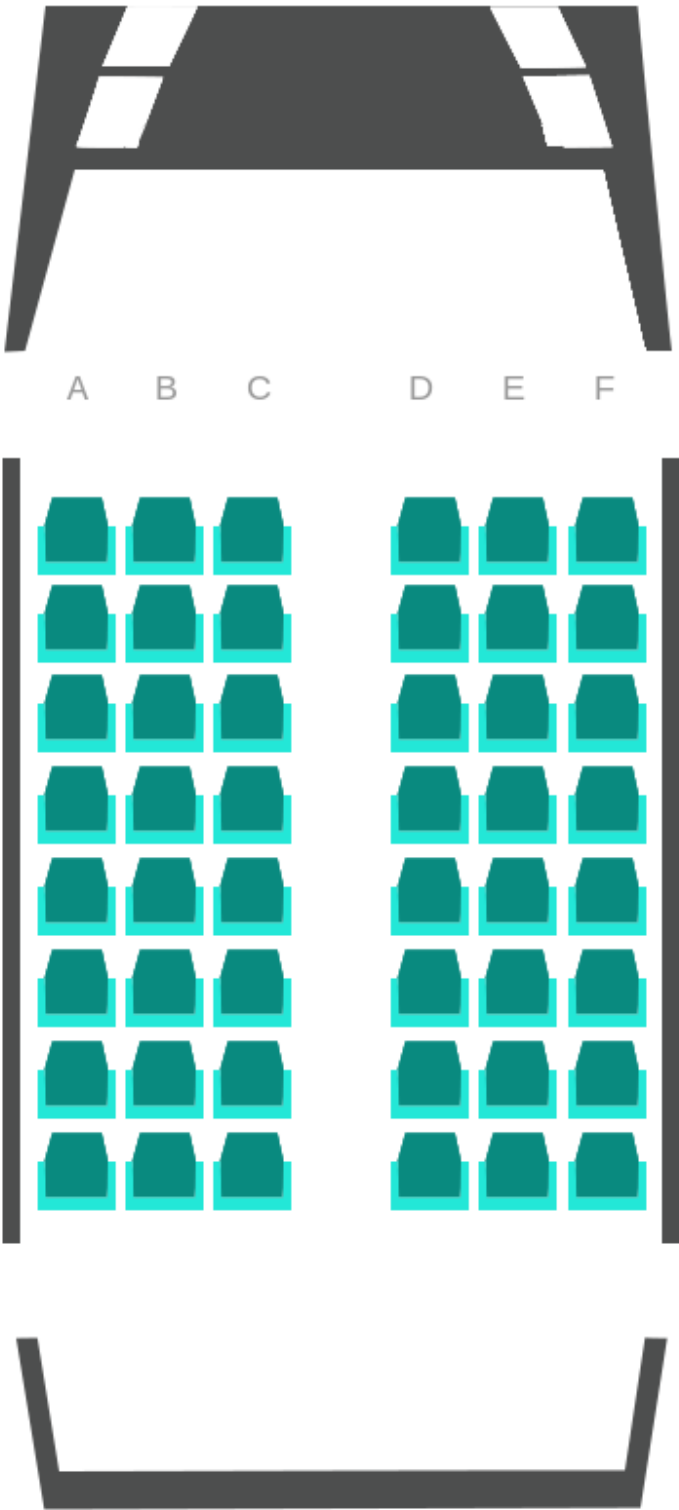
### Design, Materials and Procedure

Background assessment of participants' handedness was carried out using the twenty item Edinburgh Handedness Inventory (EHI: Oldfield, 1971). The EHI consists of a list of twenty common tasks to which the participant must respond by describing their hand preference for that task using either a '+' (preference) or a '++' (strong preference): the laterality quotient (LQ) was calculated from these responses: LQ ranges from -100 (all strong left preferences) to +100 (all strong right preferences). Participants' tendency to perceptual pseudoneglect was assessed by asking them to carry out the pencil and paper line bisection task from the Behavioural Inattention Test (Wilson, Cockburn & Halligan, 1987), in which they were asked to mark the midpoint of three 203mm lines with their right hand, and the average deviation of the mark from the true midpoint was measured.

Participants then took part in a seat booking exercise. This was specifically created for this study using e-Prime (Psychology Software Tools, Pittsburgh, PA) and implemented on a standard windows desktop PC. The display used was 1280 x 800 pixels. Participants were told that they were going to be asked to book several flights. In fact there were 32 trials, each representing a single flight. In each flight the participant was told in an information screen that they were to book a seat on a plane flight between two fictitious cities, and to choose their seat by clicking on it using the mouse operated by their right hand. They then pressed a key to move to the booking screen. The booking screen incorporated a graphical representation of an airliner, with a slightly cartoonish outline (see Figure 1). The nose and tail were truncated to aid fitting on the screen. The aircraft had eight rows of six seats with a central aisle. There were no asymmetrical landmarks on the diagram, and four doorways were shown, two on each side. No seats were shown as being booked prior to participants' selection of their seat. On half of the trials the aircraft was oriented



Figure 1. Representation of aircraft cabin used in this study, in this case showing the cabin heading upward and with A-F letter direction.



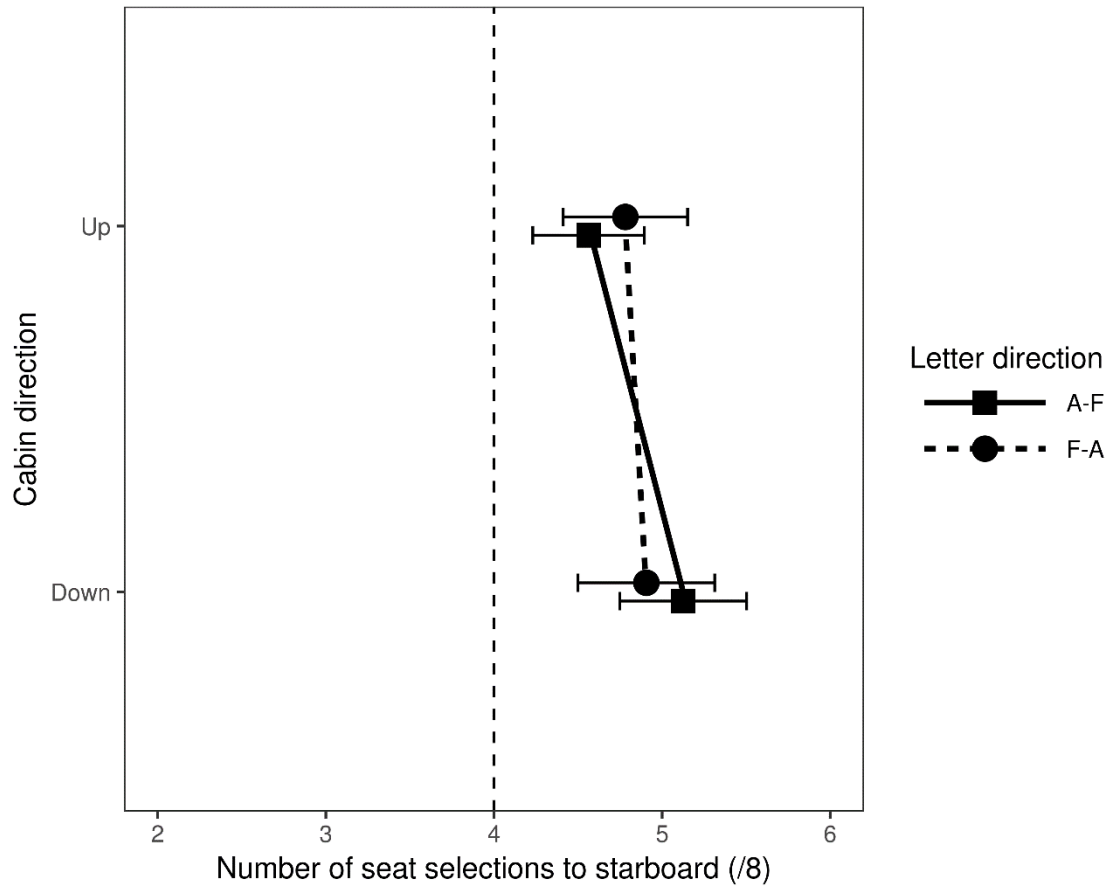
upwards towards the top of the screen, whilst on the remainder it was headed down. In the interest of clarity we subsequently refer to the left and right of the cabin as *port* and *starboard* whilst the left and right of the screen are termed *left* and *right*. The letters A to F, corresponding to individual seat labels were presented behind the flight deck, in line with the entrance doors. On half of the trials seat label A was to port and F to starboard and on the remainder the reverse was the case, with F to port. Letter pattern and direction of travel were systematically manipulated as two independent factors, there being eight trials in each factor combination. The measured variable was the number of times that participants selected to sit in a seat on the starboard side. Under the null hypothesis (no bias) then one would expect an average of 4 selections of a seat to starboard in each condition combination.

## Results

Analysis of data was conducted using R (R Core Team, 2017). Figure 2 summarises the mean number of seats selected to starboard broken down by letter pattern and cabin direction. Participants selected seats to starboard more often than to port (mean starboard selections /32 = 19.38 , SE = 1.18 ). There were slightly more selections made to starboard when the aircraft was pointing down (mean starboard selections /16 = 10.03, SE = 0.73) compared to when it was pointing up (mean = 9.34, SE = 0.83), but differences associated with letter pattern were negligible: the same number of selections to starboard were made for letter pattern 'A-F' (mean starboard selections /16 = 9.69 SE = 0.70) compared to letter pattern 'F-A' (mean = 9.69, SE = 0.65).

These data were analyzed using Bayesian methods, using the BayesFactor package in R (version 0.9.12-2; Morey & Rouder, 2015). Where Bayes factors were below 1, representing evidence in favour of the null hypothesis, we present inverse values to enable a consistent scale for reporting the presence or absence of effects. First we performed one-sample tests of the likelihood that the observed data deviated from the null hypothesis of no bias to one or other side of the cabin (i.e. testing that there was a lateral bias – a preference for choosing seats on one or other side of the cabin). The hypothesis that a cabin bias was

Figure 2. Means of total number of seats selected to starboard per participant, broken down by letter direction and cabin direction. The dotted vertical line represents the prediction of the null hypothesis that there is no lateral bias. Error bars show SE.



present was a better explanation of the data than the null hypothesis (i.e.  $\bar{x} = 16$ ) by a Bayes factor of  $BF_{10} = 5.55 (\pm 0.00\% \bar{x} = 19.38, \text{Cohen's } d = 0.50)$ .

We then derived the number of seats selected to the right of the screen, irrespective of aircraft direction. Overall the null hypothesis of no screen bias (i.e. mean = 16) was a better explanation of the data (mean = 15.31, SE = 1.02) than a hypothesis of a bias to one or other side of the screen (i.e. mean  $\neq 16$ :  $BF_{01} = 4.30, \pm 0.04\%$ ).

Bayesian one-sample t-tests as used above tell us that the data show evidence of biases, but cannot evaluate the presence of interactions between the manipulated factors: for this purpose we used a

Bayesian ANOVA with letter direction and cabin direction as fixed factors and participant ID as a random factor, and selections to starboard as the dependent variable. Models of both fixed factors, their interaction and combination were estimated. The best model was the null model including only the random participant ID factor. This was favoured over a model including cabin direction ( $BF_{01} = 3.64, \pm 0.89 \%$ ), the model including letter direction ( $BF_{01} = 4.92, \pm 3.63\%$ ), the model including both factors ( $BF_{01} = 19.44, \pm 1.87\%$ ) and the model including both factors and their interaction ( $BF_{01} = 67.16, \pm 2.11 \%$ ).

In order to understand the patterns of preference for individual seats in the cabin, heat maps were produced showing the frequency of selection of individual seats (Figure 3). The most frequently selected seat was the front starboard one. Preferences for individual rows of seats are shown in Table 1. A one way Bayesian ANOVA with row as a fixed factor, participant as a random factor and number of selections per row as the dependent variable suggested that a model including row was substantially preferred to one without (Cohen's  $f = 0.49, \eta_p^2 = 0.20$ :  $BF_{10} = 7767262, \pm 0.36 \%$ ). To probe this set of relationships we conducted pairwise comparisons using Bayesian t-tests which demonstrated that seats in Row 1, at the front of the cabin, were selected more often than seats in any other row ( $BF_{10} < 3$  in all cases,  $BF_{10} < 10$  when compared to rows 2, 4, 6, 7 & 8). Only two other comparisons indicated evidence indicating difference in selection rates (row 7 was chosen less than row 3,  $BF_{10} = 3.81$ , and row 4  $BF_{10} = 4.39$ ) and there was evidence in favour of the null hypothesis (i.e. evidence of no difference between rows) in several cases ( $BF_{01} > 3$  for rows 2 vs 4, 2 vs 5, 2 vs 6, 2 vs 8, 3 vs 4, 3 vs 5, 3 vs 8, 4 vs 5, 4 vs 8, 5 vs 8).

(Table 1 about here)

Preference for seat type (aisle, window or middle) was analyzed using a two-way Bayesian ANOVA with cabin side (port vs starboard) and seat type (window vs middle vs aisle) as fixed factors and participant ID as a random factor (see Table 1 for summary data). The best model included cabin side ( $f = 0.51, \eta_p^2 = 0.21$ ) and seat type ( $f = 0.65, \eta_p^2 = 0.30$ ) but not their interaction ( $BF_{10} = 97891901, \pm 4.53\%$ ). Omission of a model including the interaction was favoured ( $BF_{01} = 5.63, \pm 7.81\%$ ). Inclusion of side was mildly favoured over a

Table 1. Mean (s.d. in brackets) number of seat selections per participant by cabin row (1 being at the front of the aircraft and 8 at the rear) and seat type/side.

Row	1	2	3	4	5	6	7	8
	12.53	2.66	4.44	3.34	3.56	1.47	0.75	3.25
	(12.96)	(5.88)	(7.46)	(5.25)	(6.94)	(2.87)	(1.93)	(6.64)
Column	Port Window	Port Middle	Port Aisle	Starboard Aisle	Starboard Middle	Starboard Window		
	7.69	0.34	4.59	6.06	1.53	11.78		
	(7.36)	(0.83)	(6.15)	(8.12)	(5.75)	(9.75)		

Figure 3. Heat maps illustrating seat selection patterns, independent of cabin direction presented on the screen. Labels A-F represent the traditional letter pattern, so column A is on the port of the cabin and column F on the starboard. However, these data are collapsed across data from the A-F and F-R conditions and hence any effects of labelling is counterbalanced. Left Panel: values are number of selections (/1024) – darker items were selected more often. Right Panel: values are probabilities for the observed selection counts under the null hypothesis that all seats would be selected with equal likelihood. Shaded cells have  $p < .05$ , and are darker the lower the probability.

91	5	39	1	84	10	172	0.03	0.34	0.33	1	0.04	0.37	< 0.0001
17	1	14	2	26	1	26	0.39	0.32	0.39	2	0.39	0.32	0.39
19	1	21	3	28	33	40	0.4	0.32	0.4	3	0.39	0.37	0.33
24	1	19	4	24	1	38	0.4	0.32	0.4	4	0.4	0.32	0.34
26	1	23	5	14	0	50	0.39	0.32	0.4	5	0.39	0.31	0.25
17	2	5	6	9	1	13	0.39	0.32	0.34	6	0.37	0.32	0.38
11	0	4	7	1	3	5	0.38	0.31	0.34	7	0.32	0.33	0.34
41	0	22	8	8	0	33	0.32	0.31	0.4	8	0.36	0.31	0.37
A	B	C		D	E	F	A	B	C		D	E	F

model containing only seat type ( $BF_{10} = 1.74, \pm 4.63\%$ ). Window and aisle seats were selected considerably more often than middle seats – the hypotheses that there would be differences in selections between middle and window seats ( $BF_{10} = 21544, \pm 0.00\%$ ) or between middle and aisle seats ( $BF_{10} = 16.77, \pm 0.00\%$ ) were more convincing than the hypotheses proposing no differences. Evidence for or against a difference between selections for window and aisle seats was inconclusive ( $BF_{10} = 1.01, \pm 0.01\%$ ).

Overall, participants showed pseudoneglect in the line bisection task, with mean bisection error of -2.4mm (SD = 3.1mm) indicating a slight left bias, confirmed by a Bayesian one-sample t-test ( $d_z = 0.80$ :  $BF_{10} = 282.92 \pm 0.00\%$ ). There was minimal correlation between line bisection performance and seat selection bias. Two values were assessed – the number of seats selected on the right of the screen and the number selected on the starboard of the cabin. Bayesian analysis applied to correlation coefficients here uses the method of Wetzels & Wagenmakers (2012). The Pearson correlation between bisection bias and cabin-starboard bias

was  $r = -.01$ , better accounted for by the null hypothesis ( $r = 0$ ) than the alternative ( $r < 0 | r > 0$ ) ( $BF_{01} = 7.28$ ), whilst the correlation between bisection bias and screen-right bias was also better accounted for by the null ( $r = 0.05$ ,  $BF_{01} = 6.98$ ). Similarly, there was strong evidence that LQ was correlated neither with cabin-starboard bias ( $r = .02$ ,  $BF_{01} = 7.26$ ) or screen-right bias ( $r = -.13$ ,  $BF_{01} = 5.77$ ).

## Discussion

Overall, potential passengers were more likely to select seats on the starboard side of the aircraft cabin, and this preference was not related to the direction of the cabin on the screen, or to the letter direction used to describe the seats. Furthermore, there was a clear bias towards selecting seats in the front of the cabin. Finally, and perhaps unsurprisingly, seats that were at the window or in the aisle were preferred over seats in the middle of the sets of three.

In finding a right bias when airliners are oriented upwards, the current data contrast with the conclusions from those of Nicholls et al. (2013), and hence contrast with our initial predictions based on those data. It is noteworthy that, compared to previous seat selection research, Nicholls et al.'s results in aircraft were also unexpected, as previous studies in which participants were asked to select seats from plans (in non-aviation contexts) had indicated a general predisposition towards selecting seats on the right (e.g., Karev, 2000; Okubo, 2010) especially if key features of the real-world environment were represented towards the top of the page (Weyers et al., 2006). Nicholls et al.'s (2013) observation of right biases in theatre seat selection was consistent with the previous work and hence they argued that the discordant pattern seen in aircraft may have been due to the existence of a rightward turning bias, coupled with the fact that aircraft typically load from the front left entrance.

As discussed in the introduction, our present study was designed to address a range of issues that could limit the usefulness of observational studies into lateral bias in aircraft seat selection. We controlled for direction of the cabin, and found that lateral biases applied to the represented cabin itself rather than the

display screen. Controlling for the labelling of the seats showed that there was no systematic source of bias imposed by the arbitrary convention of having seats on the left of the cabin labelled from A-C and on the right from D-F. When the selection process was fully transparent, and we could be confident that it was not being driven by unknown algorithms or influenced by ecological factors (such as travelling in groups, small asymmetries of layout etc.), the data support a different conclusion from those offered by Nicholls et al. (2013) and show a clear-cut preference for choosing seats on the starboard (right) of the cabin. Whilst it is likely that the contrast between our study and that previous study may be a result of the methodology adopted here, another possibility may relate to the age of participants – several studies (e.g. Stam and Bakker, 1990; Benwell, Thut, Grant and Harvey, 2014: for reviews see Brooks et al., 2016) have shown evidence that pseudoneglect biases change over typical ageing – generally seeming to shift from left to right. Given this, it is possible that preferences for seats to port or starboard may be mediated by age, a possibility that would benefit from exploration in future work. Participants in the present study were predominantly young adults: in comparison, the age of seat choosers in Nichols et al.'s (2013) study is unknown, but costs would have been involved in booking tickets, which might support the inference that the sample may have had an older profile.

Of previous seat-selection studies, only Weyers et al. (2006) systematically manipulated the orientation of the seat displays used in selection experiments, to try and remove the effects of screen bias and their results were not clear-cut. Comparing their data with the present study suggests that directional cues might be less influential over seat selection in stationary compared to moving environments, though this suggestion too merits further research.

The selection of a seat in an aircraft or theatre, based on a diagrammatic representation of that environment is a highly representational task. A participant faced with this task (either in real life, or in a laboratory study) interacts with a two-dimensional representational depiction in order to select their most preferred seat in an imagined three-dimensional environment. The existence of a tendency for people to prefer certain seats in a cabin can be seen as a potential validation of the effectiveness of that imagery – so



evidence of preferences for seats to the front and seats to starboard that are consistent despite 180° differences in orientation or manipulation of seat labelling shows that people are basing their decisions on an imaginal representation of the target environment rather than on the image on the computer screen itself. This, in turn, implies a lateral bias which attached purely to a *representation* – it cannot have been a consequence of the memory of the original *presentation* (otherwise the bias would have been tied to the screen, not the cabin). This can therefore be seen as evidence for a pattern of *representational pseudoneglect*. This is a term that is used to describe the tendency of participants to selectively retain more detail from the left hand side of remembered arrays and was initially applied to biases favouring the recall of landmarks from the left hand side of a familiar urban environment (the Piazza del Duomo in Milan: McGeorge et al., 2007), though there is evidence of left-bias in a number of representational tasks such as tactile line bisection and mental number line bisection (e.g. Brooks et al., 2016; see also Brooks et al., 2014 for a review). The right-bias in seat selection from plans is a clear manifestation of a representational bias. It is surprising that the lateral bias in this study (and the majority of seat selection studies) is toward seats to starboard or right of represented space, in contrast to typical left biases in laboratory observations of pseudoneglect (see Jewell and McCourt, 2000; Brooks et al., 2014). One possible explanation for contrasting directions of bias between seat selection and pseudoneglect is that in the constraints of an (economy class) aircraft cabin, occupying a seat on the right would mean that the majority of activity within that cabin would take place in the left half of visual space. Interestingly, despite the extensive evidence of left biases in laboratory tasks, there seems to be a pattern for more ecological studies to yield evidence of right-bias. People make more collisions with door-frames to the right (Nichols, Loftus, Mayer & Mattingley, 2007; Nichols, Loftus, Orr and Barre 2008; Nichols, Hadgraft, Chapman, Loftus, Robertson & Bradshaw, 2010; Fujikake, Higuchi, Imanaka & Maloney, 2010), and tend to putt (Roberts and Turnbull, 2010) and kick footballs (Nichols et al., 2010) to the right. One possible – if speculative - explanation is that these actions (kicking, putting, choosing a seat) tend to involve gross positional changes which can influence the field of view itself, in contrast to laboratory tasks involving judgements about items in different locations within a

constrained visual array. Our current results would extend this pattern from visual-perceptual tasks to a representational one.

We measured laterality and horizontal line bisection bias in our participants, seeking to understand whether there were relationships between bisection error, laterality and seat selection bias. There was no evidence of any relationship between these variables, consistent with the evidence that different estimates of lateral bias do not correlate highly (Learmonth, Gallagher, Gibson, Thut & Harvey, 2015), and in particular that more representational biases (of tactile and mental number line bisection) do not correlate strongly with visual line bisection (Brooks et al. 2016). Commonality between processes underlying representation-based seat selection bias and perceptual pseudoneglect should thus not be assumed; similarly it should not be assumed that preferences for seats on maps would reflect actual preferences when people freely select seats on boarding an aircraft or entering a classroom.

In the introduction we commented on the apparently post-hoc nature of the explanations available for seating bias, and the lack of consistency in previous results. Given our results run counter to our original hypothesis, we would be remiss to ignore that our suggested explanations here are anything other than post-hoc. However, we argue that these results do merit attention, as our observation of right bias *is* consistent with the majority of the literature on seat selection – and on seat selection from maps - as well as other ecologically oriented activities. Furthermore we would argue that our study carefully controlled a number of confounds that have previously not been systematically addressed and would recommend that future research similarly attempts to address these confounds. Research designs that do so will be likely to be much more resilient to the influence of highly influential noise factors (such as explicit preferences for certain seat types) that might affect the data considerably more than the effect of representational bias, and we would predict that replication of our study using similarly well-controlled designs would yield more evidence of right-biases in seat preferences when selecting from mapping.

Minimising ground delays maximises the potential for an aircraft to make money for its owner, and the industry runs on very tight profit margins. Hence, there is growing interest in the efficient boarding of

airliners (e.g. Milne & Kelly, 2014, Steffen, 2008). Planning the allocation of seating implemented by systems involving customer-facing interfaces is a key part of this, so understanding and quantifying the nature of peoples' preferences in seating and seat selection may be valuable in these systems, leading potentially to faster aircraft turnarounds. With this in mind, one factor that seems unlikely to affect seat choice is the upward or downward orientation of cabins in displays.

### Data Availability

The data and R analysis scripts associated with this research are available at <http://osf.io/trpnq>

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